Mars Rovers continue search for signs of water

By Bill Jeffs

NASA's Spirit and Opportunity rovers completed pinpoint landings on Mars Jan. 3 and Jan. 24, respectively, and began their missions to gather knowledge about the planet and whether conditions there were ever favorable for life to have evolved.

Spirit landed in Gusev Crater, a broad depression believed to once have contained a lake. Opportunity was sent 6,600 miles away to Meridiani Planum, which scientists believe abounds in a mineral called gray hematite. The iron-rich mineral can form in lake or lucustrine environments and can also form by the thermal oxidation of volcanic materials without the presence of water.

Two members of Johnson Space Center's Astromaterials Research and Exploration Science team, Doug Ming, NASA Soil Mineralogist, and Dick Morris, NASA Physical Chemist, are playing key roles in the missions. They have been at NASA's Jet Propulsion Laboratory in Pasadena, Calif., since December, operating the rovers and sharing in science interpretation.

Morris and Ming are both members of the science team, which decides every sol (a Mars day) what science each rover will conduct that day. Morris is also the Payload Downlink Lead for the Moessbauer and Pancam instruments. He is responsible for validating science data returned from the rovers and for initial science product generation and preliminary interpretation for the science team.

Ming has served throughout the mission as the lead for either the Geochemistry and Mineralogy or the Soil and Rock Physical Properties Science Team Groups. He is responsible for defining the science that will be conducted during the sol for these science disciplines and then translating these science goals into specific observations and activities that the rovers will be commanded to perform.

Following its landing, Spirit developed serious problems, cutting off what had been a steady flow of pictures and scientific data. It stopped transmitting intelligible information back to Earth on Jan. 21. Software problems with Spirit's onboard computer memory were found to be the cause. Engineers deleted files from Spirit's flash memory and then reformatted it completely.

Soon the rover was up and running. In early February, Spirit shattered a one-day distance record on Mars, rolling nearly 70 feet across the planet's rocky surface. The drive covered more than three times the greatest distance that NASA's tiny rover Sojourner ever traveled in a day during its 1997 mission.

Spirit drove "blind" about half the distance, following a planned route to a stopping point. For the second half of the short trip, the rover drove to a second stopping point, autonomously executed a turn and then rolled onward before stopping.

Following this successful trek, drivers of the Rover, stationed at JPL, planned to send Spirit on longer excursions. NASA has sent Spirit toward a crater nicknamed Bonneville that sits more than 800 feet from where the spacecraft landed. NASA hopes the six-wheeled rover (and its twin, Opportunity) will eventually cover as much as 140 feet or more a day.

"We are heading off towards Bonneville Crater in hopes of finding rocks or other materials that have been ejected during the impact event that may show signs of past water in Gusev Crater," Ming said. "Who knows what we might find once we get to the crater rim – just look at the incredible outcrop Opportunity is exploring in a small crater on the plains of Meridiani."

Opportunity sent its first pictures of Mars to Earth on Jan. 25, delighting and puzzling scientists just hours after the spacecraft bounced to a landing on the opposite side of the red planet from its twin rover. The pictures showed a surface smooth and dark red in some places and strewn with fragmented slabs of light bedrock in others. Orbital images show that, with incredible luck, Opportunity landed in a shallow crater, facing an outcrop of bedrock.

Opportunity has been on the move at its landing site. It used its microscopic cameras and onboard spectrometers to zoom in on an outcropping of bedrock whose composition has tantalized scientists since the rover landed. Data returned by Opportunity suggest that the reddish-colored rocks that comprise the outcropping consist of a fine, sand-like matrix embedded with spherical grains of a different material. Scientists at JPL believe the outcropping, nicknamed "Opportunity Ledge," was formed by compacted layers of volcanic ash or wind-blown dust.

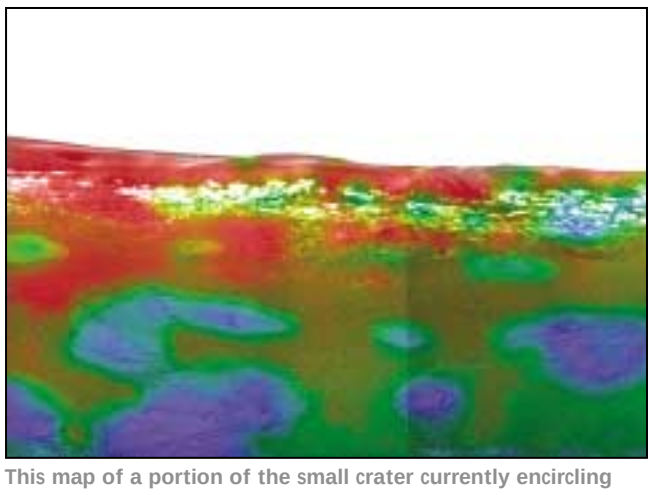
"We are keenly interested in using the science instruments on Opportunity, particularly the Moessbauer spectrometer, to learn about the mineralogical composition of this bedrock (or bedcrud)," Morris said. "It may be the key to unraveling the nature of water-driven weathering processes on Mars."

Opportunity continues to "scoot and shoot" along the face of the outcrop, embedded in the side of the crater where it landed. It will drive along the rock formation and take detailed pictures of the finely layered rocks.

Together, the 384-pound rovers make up an $820 million mission to seek out geologic evidence that Mars was a wetter world possibly capable of sustaining life. NASA launched Spirit on June 10 and Opportunity on July 7.

This image shows the Mars Exploration Rover Spirit's "hand," or the tip of the instrument deployment device, poised in front of the rock nicknamed Adirondack. In preparation for grinding into Adirondack, Spirit cleaned off a portion of the rock's surface with a stainless steel brush located on its rock abrasion tool. The image was taken by the rover's panoramic camera.

This magnified look at the Martian soil near the Mars Exploration Rover Opportunity's landing site, Meridiani Planum, shows coarse grains sprinkled over a fine layer of sand. The image was captured by the rover's microscopic imager on the 10th day, or sol, of its mission and roughly approximates the color a human eye would see. Scientists are intrigued by the spherical rocks, which can be formed by a variety of geologic processes, including cooling of molten lava droplets and accretion of concentric layers of material around a particle or "seed."



This map of a portion of the small crater currently encircling the Mars Exploration Rover Opportunity shows where crystalline hematite resides. Red and orange patches indicate high levels of the iron-bearing mineral, while blue and green denote low levels. The northeastern rock outcropping lining the rim of the crater does not appear to contain much hematite. Also lacking hematite are the rover's airbag bounce marks. This image consists of data from Opportunity's miniature thermal emission spectrometer superimposed on an image taken by the rover's panoramic camera.